

How Land Registration Affects Financial Development and Economic Growth in Thailand

Frank F.K. Byamugisha

Land registration in Thailand has significant positive long-run effects on financial development and economic growth.



Summary findings

Using an economywide conceptual framework, Byamugisha analyzes how land registration affects financial development and economic growth in Thailand.

He uses contemporary techniques, such as error correction and cointegration, to deal with such problems as time-series data not being stationary. He also uses the autoregressive distributed lag model to analyze long lags in output response to changes in land registration.

His key findings:

- Land titling has significant positive long-run effects on financial development.

- Economic growth responds to land titling following a J curve, by first registering a fall and recovering gradually, thereafter to post a long, strong rally.

- The quality of land registration services, as measured by public spending on land registration, has strongly positive and significant long-run effects on economic growth.

This paper — a product of the Rural Development and Natural Resources Sector Unit, East Asia and Pacific Region — is part of a larger effort in the region to increase the effectiveness of country assistance strategies in the area of property rights and economic development. Copies of the paper are available free from the World Bank, 1818 H Street, NW, Washington, DC 20433. Please contact Elisabeth Gelos, room MC9-344, telephone 202-473-7846, fax 202-477-2733, email address egelos@worldbank.org. Policy Research Working Papers are also posted on the Web at www.worldbank.org/research/workingpapers. The author may be contacted at fbyamugisha@worldbank.org. November 1999. (32 pages)

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**HOW LAND REGISTRATION AFFECTS FINANCIAL DEVELOPMENT
AND ECONOMIC GROWTH IN THAILAND**

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I. Introduction¹

It is now generally accepted that private property rights play a positive role in the development of market-based economies. This has been documented particularly by economic historians in the context of western Europe (North and Thomas, 1973; and Rosenberg and Birdzell, 1986). However, what has not been fully established is the magnitude of the role played by private property rights. Some attempts have been made at measuring the effects of private property rights on economic development. These have been of two kinds. The first kind has focused on estimating the relationship between private property rights and economic growth, based on cross-section regression analysis (Torstensson, 1994; and Goldsmith, 1995). The second kind has used sector studies to measure the economic effects of property rights in land on land productivity and rural or urban real estate incomes (Feder et al., 1988; Feder and Nishio, 1998; and Mighot-Adholla et al., 1991; Roth et al., 1994; and Place and Mighot-Adholla, 1998). While these empirical studies have made a very useful contribution to measuring the economic effects of property rights, they have had some shortcomings. First, due to lack of direct measures, the cross-sectional analytical studies have relied on the use of proxies, such as the degree to which property is state-owned, to measure property rights. Second, the sector studies have failed to capture the economic effects of property rights which cover more than one sector or affect the economy as a whole.

This study attempts to address these two weaknesses by: (i) estimating the economic effects of land registration on the economy-wide parameters of financial development and economic growth; and (ii) using a direct measure of private property rights -- land registration -- instead of relying on proxies. It should be noted that this is the first study to empirically estimate the relationship between land registration on the one hand and financial development and economic growth on the other.

The rest of the paper is structured as follows. Section II reviews the theoretical and conceptual framework that links land registration to financial development and economic growth. Section III deals with specification and testing of the econometric model using data from Thailand while Section IV focuses on interpretation of the empirical results. Section V draws conclusions emphasising policy implications and areas for further study.

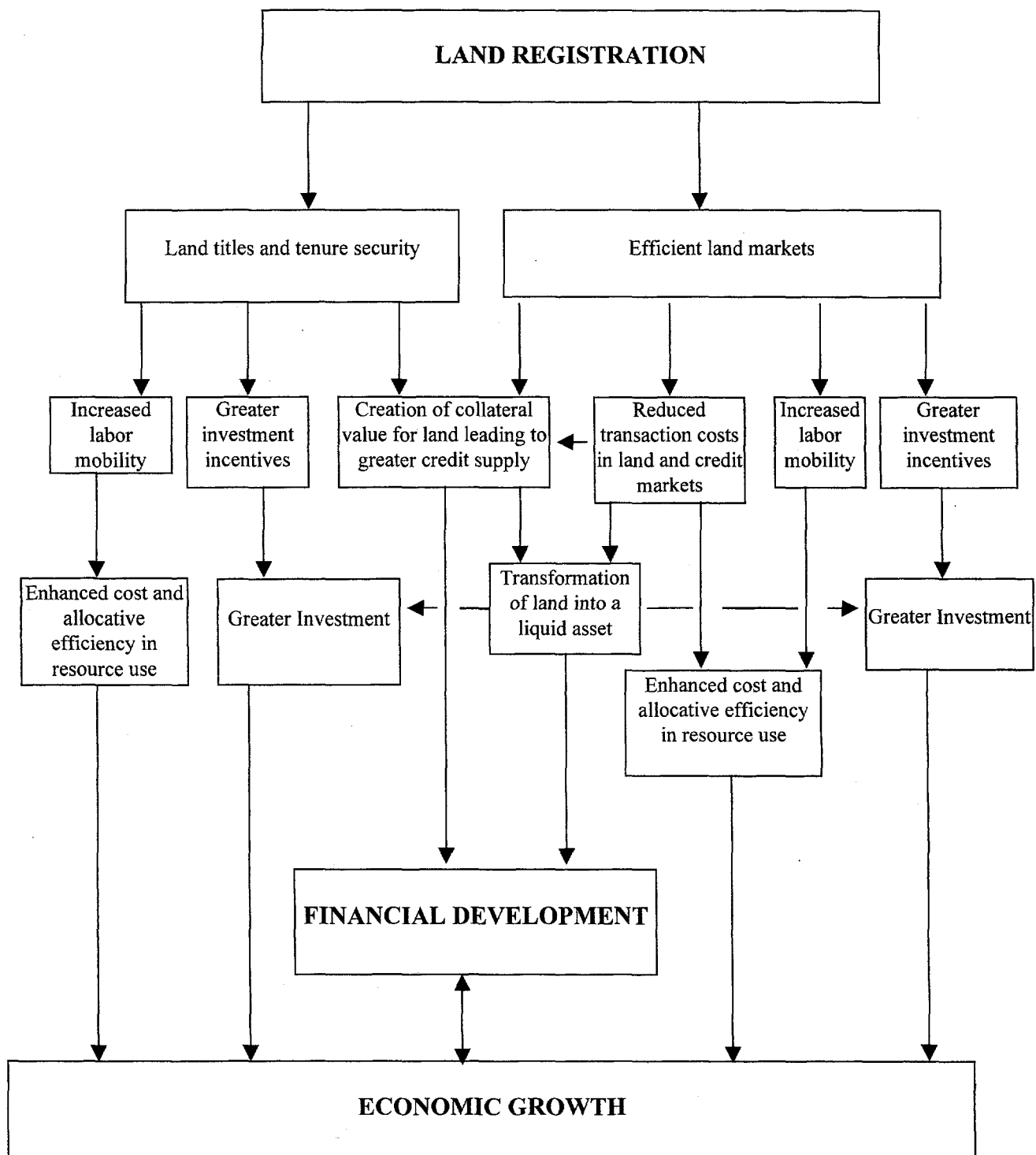
II. A Theoretical and Conceptual Framework of Land Registration, Financial Development and Economic Growth

In this section, we review the theoretical and conceptual framework, developed by Byamugisha (1999), to guide the empirical analysis of the effects of land registration on

¹ This paper has been written based on a dissertation by the author submitted as a partial requirement for a Masters Degree in Surveying at the School of Surveying of the University of East London, UK (Byamugisha, 1999a).

financial development and economic growth. It is necessary to improve upon current and past investigation approaches which have focused on one sector, contrary to common observations to the effect that land registration affects not just one sector but many sectors and the economy as a whole. The framework, represented in Figure 1, is underpinned by the theory of positive information and transaction costs.

Figure 1: A Conceptual Framework Linking Land Registration to Financial Development and Economic Growth



Source: Byamugisha (1999)

The framework builds upon the well-tested conceptual framework that links landownership security to farm productivity. It is constructed with five linkages, to map the relationship between land registration and financial development and economic growth, namely: (i) the land tenure security and investment incentives linkage; (ii) the land title, collateral and credit linkage; (iii) the land markets, transactions and efficiency linkage; (iv) the labor mobility and efficiency linkage; and (v) the land liquidity, deposit mobilization and investment linkage. The second and last linkages play a primary role in the land registration/financial development relationship although they are also important in enhancing investment which is essential for economic growth; the first, third and fourth linkages play a primary role in the land registration/economic growth relationship although they also play an important role (particularly the third linkage) in financial development.

III. Specification and Testing of the Econometric Model

In this section, we specify an econometric model necessary to estimate the effects of land registration on financial development and economic growth. We have two equations to specify and estimate: the financial development equation; and the economic growth equation. In each of the equations, land registration enters as an explanatory variable accompanied by control variables. Given the two-way relationship that links the development of the financial and real sectors of the economy as articulated in the finance and growth literature (Levine, 1996), the financial development equation would have to include a real GDP per capita variable while the economic growth equation would similarly incorporate a financial development variable. The specification approach being followed here for the financial development equation is similar to the one used by Demetriades and Luintel (1996) in their study of the effects of banking policies on financial development in Nepal. But, unlike their study, ours does not investigate short run and long run interactions between financial deepening and economic growth: we only assume the existence of the interactions and, on that basis, proceed to include financial deepening and economic growth variables in the economic growth and financial deepening equations, respectively.

The specification and estimation of the econometric model is based on time series data for Thailand for the period 1960-1996. We do not include 1997 and 1998 in our analysis partly because the required data is not available; in addition, the Asia financial crisis has hit Thailand and created so much economic and social disruption to the extent that it would only be prudent to analyze the 1997-98 period separately as a special case.

(a) Specification of the Relationship Between Land Registration and Financial Development

It has already been argued that land registration is primarily linked to financial development through two channels: the role played by land registration in enabling land to become a collateral asset which enhances financial development by expanding the market base (the number of credit worthy borrowers) for loans and by reducing financial

intermediation costs; and the role of land registration in unlocking land resources and making them available for mobilization by the financial intermediaries (Section II). We specify a financial development function that recognizes the role of land registration but also takes into account the more commonly recognized determinants of financial development. While doing so, we follow the approach of Demetriades and Luintel (1996, op. cit.). There is one important difference though between their approach and ours.

While their model deeply dissects banking policies to measure their impact on financial development and economic growth as the primary aim, ours treats banking policies as a set of variables among other control variables. In fact, due to the generally sound financial policies (free of major distortions) in Thailand, our focus on the control variables is less on financial policies and more on other variables such as per capita GDP growth. For example, opening of bank branches is not included as an independent variable because, contrary to experience elsewhere, the Thai banking regulations have not promoted opening of new bank branches (except in remote rural areas) but have instead imposed explicit taxes on the award of licenses for new bank branches (World Bank, 1990). Consequently, in addition to the two standard variables --- real GDP per capita and real deposit rate --- we have included only two banking policy variables: ceilings on deposit rates; and directed credit to agriculture.

The specification of the financial development function is presented in equation 1.

$$FD = \beta_0 + \beta_1 LR + \beta_2 LRE + \beta_3 Y + \gamma Rd + \phi Ci + \nu Da \quad (1)$$

Where:

- FD - Financial deepening
- LR - Land titling
- LRE - Land registration public expenditures
- Y - Per capita real GDP
- Rd - Real deposit interest rate
- Ci - Ceilings on deposit rates dummy
- Da - Directed lending to agriculture dummy

Equation 1 as currently specified is a long-run or equilibrium relationship. As economic systems are rarely in equilibrium, what is usually observed is a short-run or disequilibrium relationship involving lagged values of FD and of the variables on the right hand side (RHS) of equation 1. We will therefore assume the relationship takes the form of equation 2 with first order lags for all variables except the dummy variables (Ci and Da) and the real interest rate variable. For the interest rate variable, we will assume that it is in equilibrium because it tends to adjust quickly to equilibrium and also because we do not need to specify its error correction model as it is stationary I(0) (see section III (c) below). The variables in equation 2 are expressed in natural logs (except the dummies) and denoted in lower-case letters.

$$fd_t = b_0 + \mu fd_{t-1} + b_1 lr_t + b_2 lr_{t-1} + c_1 lre_t + c_2 lre_{t-1} + d_1 y_t + d_2 y_{t-1} + \gamma rd_t + \phi ci_t + v da_t + \varepsilon_t \quad (2)$$

The variables and their data sources are described in Appendix 1.

(b) Specification of the Relationship Between Land Registration and Economic Growth

We specify the land registration/economic growth relationship on the strength of the conceptual framework in which land registration is linked to economic growth through investment and efficiency of resource use. The specification of the economic growth function follows the endogenous growth theory and the related empirical work (Crafts, 1996). It is the same approach used by Torstensson (1994) in his cross-sectional study of the effects of property rights on economic growth (Section I above). In looking for control variables, we face a dilemma in that as many as 50 variables have been used in different cross-sectional economic growth studies, and many of these variables do not hold when subjected to the type of rigorous analysis that Levine and Renelt (1992) undertook. In our study, we will build on three explanatory variables that they found to be robust, namely, investment rate, growth in investment in human capital and population growth. As we are dealing with a single country case study using time series data (as opposed to the bulk of the endogenous growth studies that are cross-sectional), some of the key variables used in the endogenous growth empirical literature have been left out, namely, the initial level of real GDP per capita and the initial human investment stock. Long run economic policy variables such as inflation, real exchange rate, and government expenditures were left out also because they were stable for Thailand during the period covered by the study since macroeconomic stability was the corner stone of economic growth policy (Christensen et al., 1993).

The specification of the economic growth equation is presented in equation 3 as a long-run or equilibrium relationship.

$$Y_t = \beta_0 + \beta_1 LRT_t + \beta_2 LRE_t + \beta_3 I_t + \beta_4 SC_t + \beta_5 T_t + \beta_6 P_t + \beta_7 FD_t + \beta_8 M_t \quad (3)$$

Where:

- Y - Per capita real GDP
- LRT - Land titling
- LRE - Land registration public expenditures
- I - Ratio of investment to GDP
- SC - Investment in human capital (Secondary School Enrolment)
- T - Ratio of Trade to GDP
- P - Population
- FD - Financial development
- M - Ratio of manufacturing output to GDP

As economic systems are rarely in equilibrium, we will re-specify equation 3 as a short-run or disequilibrium relationship involving lagged values of Y and of the variables on the right hand side (RHS) of the equation as we did for the financial development equation. We will assume the relationship takes the form of equation 4 with first order lags for all variables. The variables in equation 3 are expressed in natural logs and denoted in lower-case letters.

$$y_t = b_0 + \mu y_{t-1} + b_1 lrt_t + b_2 lrt_{t-1} + c_1 lre_t + c_2 lre_{t-1} + d_1 i_t + d_2 i_{t-1} + e_1 sc_t + e_2 sc_{t-1} + f_1 t_t + f_2 t_{t-1} + g_1 p_t + g_2 p_{t-1} + h_1 fd_t + h_2 fd_{t-1} + i_1 m_t + i_2 m_{t-1} + \varepsilon_t \quad (4)$$

The variables and their data sources are described in Appendix 1.

(c) Empirical Testing and Analysis

(i) Unit Root Tests²

More often than not, time series data are non-stationary. In this section, we carry out unit root tests using the Augmented Dickey-Fuller (ADF) method (Dickey and Fuller, 1979) to test for non-stationarity for the key variables in the economic growth and financial deepening equations, using Microfit 4.0 (Pesaran and Pesaran, 1997). The existence of non-stationarity in a data series would mean that, if hit by a shock, a variable would suffer permanent change, since non-stationary variables have a non-constant mean, variance and covariance. On the other hand, faced by a shock, a stationary data series will over time return to its unconditional mean; that is, the effects of the shock will dissipate, leaving only temporary effects on the time series.

The ADF tests show that only the real deposit rate variable (RD) is stationary at I(0) while the rest of the variables attain stationarity at I(1) except the per capita income variable (Y) that attains stationarity at I(2). These ADF results are further verified using correlograms of autocorrelation coefficients. Stationarity is achieved when the

² We have also carried out other pre-tests such as scatter plots involving dependent variables and the land registration variables in which a positive association was found. Variables were also plotted against time to detect patterns, trends and outliers. In addition to looking out for outliers as a check on data quality, we were particularly interested in detecting shifts or structural changes in the time series data as a basis to select the most appropriate method for unit root tests for stationarity. Specifically, in situations of a permanent shift which could be due to policy changes or external shocks, the normal unit root tests such as the Augmented Dickey-Fuller (ADF) and Phillips-Perron tests, would have low testing power. Such breaks can make an otherwise stationary time series data appear non-stationary. If such breaks in data are known, the unit root tests can be adjusted by including dummy variables to ensure there are as many deterministic regressors as there are deterministic components in the data generating process. If the breaks in data are unknown, other methods can be used for unit root testing such as the Perron method (Perron, 1989). A review of the graphs indicate that there are no breaks in data that would reduce the power of the normal unit root test methods. Hence, the ADF test can be used to carry out the unit root tests and was indeed selected for the test. The scatter plots against time and between dependent and land registration variables can be provided by the author upon request.

correlogram falls rapidly to or toward zero and stabilizes thereafter around zero at higher orders; this contrasts with a steadily declining correlogram which one gets in a situation of non-stationarity. A summary of the ADF test results is presented in Table 1 below; the correlograms and the details of the ADF tests are not reported here. They can be found in Byamugisha (1999).

Table 1: Unit Root Tests

Variable	Order of ADF test	Test Statistic (without trend)	Test Statistic (with trend)	Critical Value (95%)	Level of Integration
Y	ADF(10)	-3.3966	-	-3.0039	I(2)
FDC	ADF(0)	-2.5555	-	-2.9750	I(1)
			-3.6780	-3.5867	I(1)
FD	ADF(1)	-3.8811	-	-2.9750	I(1)
			-3.9113	-3.5867	I(1)
P	ADF(0)	-1.8012	-	-2.9750	
			-5.4375	-3.5867	I(1)
RD	ADF(1)	-3.0410	-	-2.9706	I(0)
			-3.5379	-3.5796	I(0)
I	ADF(0)	-5.0305		-2.9750	I(1)
			-5.0699	-3.5867	I(1)
T	ADF(0)	-5.5522		-2.9750	I(1)
			-5.4432	-3.5867	I(1)
M	ADF(1)	-3.8506		-2.9750	I(1)
			-3.8588	-3.5867	I(1)
LRE	ADF(0)	-3.9534	-	-2.9750	I(1)
			-4.5067	-3.5867	I(1)
LRT	ADF(0)	-3.5900	-	-2.9750	I(1)
			-3.6263	-3.5867	I(1)
SC	ADF(2)	-3.1424	-	-2.9750	I(1)
			-3.1441	-3.5867	

Results obtained using Microfit 4.0 by Pesaran and Pesaran (1997).

(ii) Non-Stationarity, the ECM Model and Parsimonious Specification

Unit root tests carried out above have indicated that, for all variables (with an exception of the real deposit rate variable), non-stationarity exists with implications that a classical regression analysis would produce spurious and inconsistent estimates. To overcome the problem of non-stationarity, we develop a specification of the Error Correction Model (ECM), as was done by Demetriades and Luintel (1996) and Khan and Hasan (1998)³. Alternatively, we could have used a vector autoregression (VAR)

³ For a survey of ECMs, see Alogoskoufis and Smith (1991).

framework with cointegration such as proposed by Johansen (1988). We opted against this because the VAR would have made ‘Very Awful Regressions’, as many econometricians humorously call the VARs (Harvey, 1997, p.199) since our econometric models have many variables one of which (the land titling variable) needs to be lagged up to five or more orders in the economic growth equation.

We start with specification of an ECM for the financial deepening equation (equation 2). We leave the real interest rate variable (Rd) out of the ECM specification as it has been found to be stationary at I(0). This helps us to make savings on the degrees of freedom. Similarly, we leave out the dummy variables (Da and Ci) as they would not be expected to be non-stationary.

As a first step in specifying the ECM, we reparameterize equation 2 by adding and subtracting the terms $(b_1 + b_2) lr_{t-1}$, $c_1 lre_{t-1}$ and $d_1 y_{t-1}$ from the right hand side to produce equation 5:

$$fd_t = b_0 + \mu fd_{t-1} + b_1 \Delta lr_t + c_1 \Delta lre_t + d_1 \Delta y_t + (b_1 + b_2) lr_{t-1} + (c_1 + c_2) lre_{t-1} + (d_1 + d_2) y_{t-1} + \gamma rd_t + \phi ci_t + vda_t + \varepsilon_t \quad (5)$$

Subtracting fd_{t-1} from both sides of the equation, we have:

$$\Delta fd_t = b_0 - (1 - \mu) fd_{t-1} + b_1 \Delta lr_t + c_1 \Delta lre_t + d_1 \Delta y_t + (b_1 + b_2) lr_{t-1} + (c_1 + c_2) lre_{t-1} + (d_1 + d_2) y_{t-1} + \gamma rd_t + \phi ci_t + vda_t + \varepsilon_t \quad (6)$$

We further reparameterize to generate the ECM in equation 7:

$$\Delta fd_t = b_1 \Delta lr_t + c_1 \Delta lre_t + d_1 \Delta y_t - \lambda (fd_{t-1} - \beta_0 - \beta_1 lr_{t-1} - \beta_2 lre_{t-1} - \beta_3 y_{t-1}) + \gamma rd_t + \phi ci_t + vda_t + \varepsilon_t \quad (7)$$

Where: $\lambda = 1 - \mu$; $\beta_0 = b_0/\lambda$; $\beta_1 = (b_1 + b_2)/\lambda$; $\beta_2 = (c_1 + c_2)/\lambda$; $\beta_3 = (d_1 + d_2)/\lambda$

To estimate equation 7, it is necessary to multiply out the disequilibrium error term and rewrite the equation as:

$$\Delta fd_t = \lambda \beta_0 + b_1 \Delta lr_t + c_1 \Delta lre_t + d_1 \Delta y_t + \lambda \beta_1 lr_{t-1} + \lambda \beta_2 lre_{t-1} + \lambda \beta_3 y_{t-1} - \lambda fd_{t-1} + \gamma rd_t + \phi ci_t + vda_t + \varepsilon_t \quad (8)$$

Further lags can be added to one or more variables and more ECMs constructed for them. For example, if a second order lag is added for lr_t in equation 2, we would obtain an ECM similar to equation 8 but having additional regressors $\mu_2 \Delta y_{t-1}$ and $b_3 \Delta lr_{t-1}$, as in equation 9.

$$\Delta fd_t = \lambda \beta_0 - \mu_2 \Delta y_{t-1} + b_1 \Delta lr_t + c_1 \Delta lre_t + d_1 \Delta y_t - b_3 \Delta lr_{t-1} + \lambda \beta_1 lr_{t-1} + \lambda \beta_2 lre_{t-1} + \lambda \beta_3 y_{t-1} - \lambda fd_{t-1} + \gamma rd_t + \phi ci_t + vda_t + \varepsilon_t \quad (9)$$

Next, we embark on specification of the economic growth equation (equation 4) following the same steps as we have used to specify the financial development equation. We obtain equation 10 as the ECM for the economic growth equation.

$$\Delta y_t = \lambda\beta_0 + b_1\Delta lr_t + c_1\Delta lr_{e,t} + d_1\Delta i_t + e_1\Delta sc_t + f_1\Delta t_t + g_1\Delta p_t + h_1\Delta m_t + i_1\Delta fd_t + \lambda\beta_1lr_{t-1} + \lambda\beta_2lr_{e,t-1} + \lambda\beta_3i_{t-1} + \lambda\beta_4sc_{t-1} + \lambda\beta_5t_{t-1} + \lambda\beta_6p_{t-1} + \lambda\beta_7m_{t-1} + \lambda\beta_8fd_{t-1} - \lambda y_{t-1} + \varepsilon_t \quad (10)$$

We could, as we did for the financial development equation, add further lags for lr_t (the land titling variable) in equation 4 and construct more ECMs for the economic growth equation. If we add second order lags, we would obtain an ECM similar to equation 10, but having additional regressors $\mu_2\Delta y_{t-1}$ and $b_3\Delta lr_{t-1}$ as in equation 11.

$$\Delta y_t = \lambda\beta_0 - \mu_2\Delta y_{t-1} + b_1\Delta lr_t + c_1\Delta lr_{e,t} + d_1\Delta i_t + e_1\Delta sc_t + f_1\Delta t_t + g_1\Delta p_t + h_1\Delta m_t + i_1\Delta fd_t - b_3\Delta lr_{t-1} + \lambda\beta_1lr_{t-1} + \lambda\beta_2lr_{e,t-1} + \lambda\beta_3i_{t-1} + \lambda\beta_4sc_{t-1} + \lambda\beta_5t_{t-1} + \lambda\beta_6p_{t-1} + \lambda\beta_7m_{t-1} + \lambda\beta_8fd_{t-1} - \lambda y_{t-1} + \varepsilon_t \quad (11)$$

We make test runs, using the ‘General to Specific Approach’, the so-called Hendry’s approach, to arrive at parsimonious specifications (Thomas, 1997). We start with regression analysis for the financial deepening equation (equation 8) but without the land registration variables. The real deposit rate variable and the two dummies (for directed lending to agriculture and ceilings on deposit interest rates) turn out to be insignificant and are therefore dropped from the equation (regression results are not reported here; they can be made available by the author upon request). There is no need for F-testing for the restriction imposed by dropping these variables since their coefficients are insignificant within an ECM specification. We find that reducing the number of explanatory variables does not cause deterioration in the diagnostic statistics. Rather, by saving on the degrees of freedom, the reduction in the number of explanatory variables improves our testing for statistical significance and generates a simple model. We therefore use this simplified model --- equation 12 --- as the basis for estimating the financial deepening equation.

$$\Delta fd_t = \lambda\beta_0 + b_1\Delta lr_t + c_1\Delta lr_{e,t} + d_1\Delta y_t + \lambda\beta_1lr_{t-1} + \lambda\beta_2lr_{e,t-1} + \lambda\beta_3y_{t-1} - \lambda fd_{t-1} + \varepsilon_t \quad (12)$$

Similarly, we undertake a regression analysis of the economic growth equation as specified in equation 10 but without the land registration variables. Our findings indicate that the population (p), manufacturing (m) and human capital (secondary school enrolment, sc) variables are insignificant and are therefore dropped from the equation (regression results are not reported here, but they can be made available by the author upon request)⁴. Again, there is no need for F-testing for the restriction imposed by

⁴ Our findings on secondary school enrolment are consistent with the conclusions of Christensen et al. (1993) who argue that investment in secondary school education in Thailand was lagging behind (compared to other countries at the same level of development) and did not play a significant role in the high growth rates achieved by Thailand; on the other hand, investment in primary education was high and could have played a supportive role in the growth process.

dropping these variables since their coefficients are insignificant within an ECM specification. We find that their removal from the equation does not lead to a deterioration in the diagnostic statistics. Dropping the three variables leads to equation 13 which is a simpler model that we will use to estimate the economic growth equation. We will also estimate the economic growth equation using a simplified equation derived from equation 11 (with second order lags) but without the three omitted variables; it is presented as equation 14. If necessary, we will estimate also a model with third order lags, similar to equation 14 but with additional regressors y_{t-2} and Δlr_{t-2} .

$$\Delta y_t = \lambda\beta_0 + b_1\Delta lr_t + c_1\Delta lre_t + d_1\Delta i_t + e_1\Delta t_t + f_1\Delta fd_t + \lambda\beta_1lr_{t-1} + \lambda\beta_2lre_{t-1} + \lambda\beta_3i_{t-1} + \lambda\beta_4t_{t-1} + \lambda\beta_5fd_{t-1} - \lambda y_{t-1} + \varepsilon_t \quad (13)$$

$$\Delta y_t = \lambda\beta_0 - \mu_2\Delta y_{t-1} + b_1\Delta lr_t + c_1\Delta lre_t + d_1\Delta i_t + e_1\Delta t_t + f_1\Delta fd_t - b_3\Delta lr_{t-1} + \lambda\beta_1lr_{t-1} + \lambda\beta_2lre_{t-1} + \lambda\beta_3i_{t-1} + \lambda\beta_4t_{t-1} + \lambda\beta_5fd_{t-1} - \lambda y_{t-1} + \varepsilon_t \quad (14)$$

It is important to underline the point that, on the strength of the ECM specification, t-ratios can be used to omit variables in the general to specific approach. This is due to the fact that the ECM representation reduces problems of multicollinearity hence increasing the reliability and stability of t-ratios in testing for statistical significance (Thomas, 1997, op. cit.). A correlation matrix of the explanatory variables in the ECM specification shows that collinearity between the bulk of the variables is greatly reduced, making them almost orthogonal. Details of the correlation matrix are not reported here but can be made available by the author upon request.

With our simplified equations (12, 13 and 14), various regression runs are made. The results are presented and discussed in Section IV.

(iii) Lagged Response, Autoregressive Distributed Lag Model and Co-integration

Experience from implementing land titling projects indicates that the impact of land titling on productivity and output takes a long time to materialize, at least 3-5 years (Onchan and Aungsumalin, 1993). Hence, modelling the response of economic growth to land titling would require many lags which the ECM cannot handle beyond 3 lags as it would become overly complex and eat up too many degrees of freedom. A model well suited to handle such a large number of lags is the autoregressive distributed lag (ARDL) model which we are going to develop from equation 4 (without the three omitted variables) as an 8th order ARDL model where only the land titling variable takes up to 8 lags; the dependent variable is lagged also once as a regressor⁵. We obtain equation 15:

$$y_t = b_0 + \mu y_{t-1} + b_1lr_t + b_2lr_{t-1} + \dots + b_8lr_{t-8} + c_1lre_t + d_1i_t + e_1t_t + f_1fd_t + \varepsilon_t \quad (15)$$

We reparameterize equation 15, by subtracting y_{t-1} from both sides of the equation, in order to reduce the y_t (the dependent variable) from an I(2) to approximately I(1) so that it

⁵ For a survey of ARDL models, see Hendry et al. (1984).

is at par in the order of integration with the other variables. We obtain equation 16 which we estimate. The estimation results are presented in Section IV.

$$\Delta y_t = b_0 + (\mu-1)y_{t-1} + b_1 lrt_t + b_2 lrt_{t-1} + \dots b_9 lrt_{t-9} + c_1 lre_t + d_1 i_t + e_1 t_t + f_1 fd_t + \varepsilon_t \quad (16)$$

Since all the variables in equation 16 are generally integrated I(1), we carry out a residual-based ADF method for cointegration, proposed by Engle and Granger (1987). If the residuals were to be found stationary, we would conclude that the related variables are cointegrated, that is, having some linear combination that is integrated I(0). Consequently, an OLS regression would not produce spurious and inconsistent estimates despite the variables being non-stationary. The results of the estimation of the ARDL and of the cointegration tests are presented and discussed in Section IV.

IV. Empirical Results and their Interpretation

The results of the regression analyses are presented in Tables 2 to 6 for the financial deepening and economic growth equations. We now embark on interpreting the estimation results, starting with the financial deepening equation in section IV(a) and thereafter dealing with the results of the economic growth equation in section IV(b).

(a) Results of the Financial Deepening Equation

We first present the estimation results of the standard financial deepening equation in column 1 of Table 2. As expected, the explanatory variables representing per capita income and financial deepening (lagged) all carry the expected signs. It should be noted that the negative sign for the latter's coefficient refers to $-\lambda$ which is equivalent to $-(1-\mu)$, indicating that μ is positive. The per capita income and financial deepening variables, lagged by one period to represent the long run or equilibrium situation, have a strongly significant effect on financial deepening while the change in per capita income variable, representing a short-run or disequilibrium situation, is statistically significant at 5 percent level. It is important to note at this point that the variables for real deposit rate, directed credit to agriculture and ceilings on deposit rates were dropped from the equation in the parsimonious specification because they were found to be statistically insignificant (Section IIIc).

Next, we present the results of the financial deepening equation where the land registration variables have been added to the standard equation. The results are presented in column 2. The estimation results have been subjected to and passed the diagnostic tests whose results are also presented in Table 1. The Ramsey RESET test (functional form) confirms that the model is correctly specified. In addition, the estimation results have passed the tests for normality, serial correlation and heteroscedasticity.

The variables in the standard equation have maintained their expected signs and have remained statistically significant. However, the added land registration variables have produced mixed results. The variable for public expenditure on land registration has

the expected sign but is not significant both in the short run and long run. As for the land titling variable, it has an unexpected negative sign in the short-run but a positive sign in its long-run specification. Its short-run effects on financial deepening are insignificant; but in the long run, its effects are significant at 5 percent level. This analysis indicates that land titling has a significant effect on financial development in the long run but none in the short run.

Table 2: Financial Deepening Equation – ECM Model
Dependent Variable: ΔLogFDC
36 Annual Observations (1961-1996) used for Estimation in Columns 1 and 2

Variables	Column 1	Column 2
Intercept	-4.0656*** (-2.5306)	-8.0097*** (-3.9259)
$\log \text{FDC}_{t-1}$	-0.29369*** (-2.5025)	-0.60247*** (-3.9180)
$\Delta \log Y$	0.52359** (1.7410)	0.42383* (1.4600)
$\Delta \log \text{LRE}$	---	0.041802 (0.79231)
$\Delta \log \text{LR}$	---	-0.35445 (-1.1770)
LogY_{t-1}	0.37682*** (2.5561)	0.38618*** (2.6003)
$\log \text{LRE}_{t-1}$	---	0.040195 (1.0675)
$\log \text{LR}_{t-1}$	---	0.21982** (2.3031)
R^2	0.26	0.44
DW	1.82	1.76
Diagnostic Tests		
Serial Correlation ^a	F (1, 31) = 0.31956 [0.576]	F (1, 27) = 0.94415 [0.340]
Functional Form ^b	F (1, 29) = 0.10931 [0.743]	F (1, 27) = 0.30739 [0.584]
Normality ^c	$\chi^2_{(2)} = 4.7105$ [0.095]	$\chi^2_{(2)} = 0.34358$ [0.842]
Heteroscedasticity ^d	F (1, 34) = 1.8858 [0.594]	F (1, 34) = 0.40101 [0.531]

a Lagrange Multiplier test of residual serial correlation

b Ramsey RESET test using the square of the fitted values

c Based on a test of skewness and kurtosis of residuals

d Based on the regression of squared residuals on squared fitted values

*, ** and *** indicate significance levels of 10, 5 and 1 percent, respectively.

Figures corresponding to parameters are coefficient estimates, with related t-ratios in brackets.

Results and footnotes obtained using Microfit 4.0 by Pesaran and Pesaran (1997).

(b) Results of the Economic Growth Equation

The economic growth equation has been estimated using two different models: the ECM; and the ARDL. The ECM has the advantage of having a capability to fully deal with the problem of non-stationarity; however, it is inadequate in handling high order

lags. High order lags are best handled by ARDL models. But for their results to be valid, the variables must pass a test for co-integration if they are integrated $I(1)$ as is the case in this study.

We first present the estimation results of the ECM model and the related diagnostic tests (Table 3). The DW and LM diagnostic tests for the results in columns 1 and 3 indicate the presence of serial correlation but not serious enough to affect model specification: the Ramsey RESET tests indicate in both cases that the models are correctly specified. The Ramsey RESET test indicates some mis-specification of the model in column 2 but this is not supported by the LM test, indicating that the mis-specification problem is not serious. The estimation results have passed the tests for normality and heteroscedasticity without any qualification.

Table 3: Economic Growth Equation – ECM Model
Dependent Variable: $\Delta \log Y$
36 Annual Observations (1961-1996) used for Estimation in Columns 1& 2, 35
Observations (1962-96) in Column 3 and 34 (1968-96) in Column 4

Variables	Column 1	Column 2	Column 3	Column 4
Intercept	1.8952*** (2.7325)	3.3086*** (4.5632)	2.3236*** (3.2943)	2.5684*** (3.0743)
$\Delta \log Y_{t-1}$	---	---	0.22172* (1.4870)	0.10531 (0.58893)
$\Delta \log Y_{t-2}$	---	---	---	0.12222 (0.6373)
$\Delta \log I$	0.10020*** (2.5896)	0.07221** (2.0030)	0.12037*** (2.7907)	0.12314*** (2.6974)
$\Delta \log T$	0.033719 (0.84670)	0.04727* (1.3424)	0.01122 (0.30615)	0.03512 (0.8322)
$\Delta \log FD$	-0.066434 (-1.0718)	0.02326 (0.3572)	-0.00741 (-0.12514)	-0.07486 (-0.8763)
$\Delta \log LRE$	---	0.2132 (0.0075)	0.03872* (1.3855)	0.05028* (1.4769)
$\Delta \log LRT$	---	-0.17144* (-1.5801)	-0.12366 (-1.2249)	-0.2035 (-1.6217)
$\Delta \log LRT_{t-1}$	---	---	-0.11956 (-1.1129)	-0.12933 (-1.0568)
$\Delta \log LRT_{t-2}$	---	---	---	-0.1896 (-1.2227)
$\log Y_{t-1}$	-0.15730*** (-2.6207)	-0.25504*** (-3.9316)	-0.21961*** (-3.7134)	-0.2863*** (-3.4612)
$\log I_{t-1}$	0.076580* (1.4513)	0.03432 (0.7126)	0.00117 (0.02508)	0.032199 (0.52667)
$\log T_{t-1}$	0.091469*** (2.7195)	0.14926*** (4.1831)	0.09934*** (2.7792)	0.11236*** (2.7942)
$\log FD_{t-1}$	0.083853** (2.3480)	0.14516*** (3.7135)	0.09092** (2.3324)	0.05622 (1.0976)
$\log LRE_{t-1}$	---	0.07065*** (2.6624)	0.08668*** (3.5118)	0.12279*** (3.2485)
$\log LRT_{t-1}$	---	-0.05287*** (-3.2025)	-0.028967** (-1.7674)	-0.01473 (-0.6886)
R ²	0.53	0.69	0.79	0.81
DW	1.23	1.7	2.50	2.46
Diagnostic Tests				
Serial Correlation ^a	F (1, 27) = 5.7484 [0.024]	F (1, 23) = 4263 [0.520]	F (1, 20) = 4.437 [0.048]	F (1, 17) = 3.516 [0.078]

Functional Form ^b	F (1, 27) = 3.1634 [0.087]	F (1, 23) = 5.9877 [0.022]	F (1, 20) = 0.027314 [0.870]	F (1, 17) = 0.6950 [0.979]
Normality ^c	$\chi^2_{(2)} = 1.5021$ [0.472]	$\chi^2_{(2)} = 0.86174$ [0.650]	$\chi^2_{(2)} = 0.88741$ [0.642]	$\chi^2_{(2)} = 0.1978$ [0.906]
Heteroscedasticity ^d	F (1, 34) = 0.34975 [0.558]	F (1, 34) = 0.4268 [0.518]	F (1, 33) = 0.91864 [0.345]	F (1, 32) = 0.85404 [0.362]

a Lagrange Multiplier test of residual serial correlation

b Ramsey's RESET test using the square of the fitted values

c Based on a test of skewness and kurtosis of residuals

d Based on the regression of squared residuals on squared fitted values

*, ** and *** indicate significance levels of 10, 5 and 1 percent, respectively.

Figures corresponding to parameters are coefficient estimates, with related t-ratios in brackets.

Results and footnotes obtained using Microfit 4.0 by Pesaran and Pesaran (1997).

Column 1 of Table 3 shows estimation results of the standard economic growth equation which contains control variables: the explanatory variables are carrying the expected signs except for the short-run variable for financial deepening (FD) which is in any case statistically insignificant. In addition, with the exception of the investment variable (I) which is significant in the short-run but insignificant in the long-run, all the variables are on the whole strongly significant in the long-run but insignificant in the short-run. As economic theory is concerned about the long run, also referred to as equilibrium, these results are generally consistent with our expectations.

Next, we present the results of the economic growth equation to which the land registration variables have been added to the standard equation: column 2 (of Table 3) presents land titling with one lag while columns 3 and 4 have it with 2 and 3 lags, respectively. In addition, columns 2, 3 and 4 carry the variable for public expenditure on land registration, without any lags. The variables from the standard economic growth equation (control variables) remain statistically significant and maintain their signs in all columns 2, 3 and 4 except for the financial deepening variable which becomes insignificant in column 4. Furthermore, the financial development variable turns negative in column 3. The estimation results for the control variables are basically buoyant.

The variable for public expenditure on land registration is strongly significant in the long-run in all cases and carries the expected sign. It is insignificant in the short-run. This would indicate that public expenditure on land registration --- an indicator of the quality of land registration services in support of land transactions --- has a strongly significant and positive effect on economic growth in the long run but not in the short-run. The land titling variable on the other hand carries an unexpected negative sign and is significant in the long-run for the first and second order lags but insignificant for the third order lag; it is uniformly insignificant in the short-run. These results indicate that the land titling variable has a negatively significant effect on economic growth in the first and second years, following the issuing of land titles, but the effects fade away in the third year.

As we noted in the last section, the ECM model is not suited to handle high order lags that one would expect to find in the relationship between land titling and economic growth. We have therefore decided to use an ARDL model to deal with the multi-order lags of the land titling/economic growth relationship. The estimation results and the

related diagnostic tests are presented in Table 4. The estimation results have passed all the diagnostic tests for specification, normality, serial correlation and heteroscedasticity.

Column 1 of Table 4 shows estimation results of the standard economic growth equation in the ARDL model: the explanatory variables are carrying the expected signs. In addition, they are all statistically significant, and strongly so for the per capita income (lagged) and investment variables. The coefficient of the lagged per capita variable, μ , is also positive since the negative sign actually refers to $-\lambda$ which is equivalent to $-(1-\mu)$ (see Section IVa).

Next, we present the results of the economic growth equation to which the land registration variables have been added to the standard equation: column 2 (of Table 4) presents land titling with zero and four period lags while column 3 has it with zero and eight period lags. In addition, columns 2 and 3 carry the variable for public expenditure on land registration, without any lags. The variables from the standard economic growth equation remain statistically significant in both columns 2 and 3 except for the financial deepening variable in column 2 and the trade variable in column 3. Furthermore, the financial development variable turns negative in column 3. While there are these aberrations that we are unable to explain, the estimation results are basically buoyant.

Table 4: Economic Growth Equation – ARDL Model
Dependent Variable: $\Delta \log Y$
36 Annual Observations (1961-1996) used for Estimation in Column 1, 33 (1964-96) in
Column 2 and 29 (1968-96) in Column 3

Variables	Column 1	Column 2	Column 3
Intercept	1.7191*** (2.9756)	1.8816*** (2.8476)	0.11886 (0.14633)
$\log Y_{t-1}$	-0.13912*** (-2.7515)	-0.24879*** (-4.1521)	-0.20547*** (-4.0737)
$\log I$	0.12085*** (3.0179)	0.14649*** (3.0471)	0.15493*** (2.8436)
$\log FD$	0.060267** (1.8879)	-0.016980 (-0.25787)	-0.14624** (-1.9245)
$\log T$	0.072919** (2.2896)	0.081153** (2.3515)	0.0064441 (0.14567)
$\log LRE$	---	0.099802*** (2.8593)	0.088113*** (3.8728)
$\log LRT$	---	-0.11418** (-2.1522)	-0.058014** (-2.2898)
$\log LRT_{t-4}$	---	0.13156** (1.8818)	---
$\log LRT_{t-8}$	---	---	0.15694*** (3.2849)
R^2	0.41	0.59	0.70
DW	1.51	1.94	1.97
Diagnostic Tests			
Serial Correlation ^a	F (1, 29) = 3.1766 [0.085]	F (1, 24) = 0.012213 [0.913]	F (1, 20) = 0.5234E-4 [0.994]
Functional Form ^b	F (1, 29) = 1.1609 [0.290]	F (1, 24) = 0.19535 [0.662]	F (1, 20) = 0.51799 [0.480]
Normality ^c	$\chi^2_{(2)} = 1.3812$ [0.501]	$\chi^2_{(2)} = 1.2804$ [0.527]	$\chi^2_{(2)} = 0.18792$ [0.910]
Heteroscedasticity ^d	F (1, 34) = 0.67683 [0.416]	F (1, 31) = 0.72521 [0.401]	F (1, 27) = 0.018070 [0.894]

^a Langrange Multiplier test of residual serial correlation

^b Ramsey's RESET test using the square of the fitted values

^c Based on a test of skewness and kurtosis of residuals

^d Based on the regression of squared residuals on squared fitted values

*, ** and *** indicate significance levels of 10, 5 and 1 percent, respectively.

Figures corresponding to parameters are coefficient estimates, with related t-ratios in brackets.

Results and footnotes obtained using Microfit 4.0 by Pesaran and Pesaran (1997).

The variable for public expenditure on land registration is strongly significant in both cases and carries the expected sign. The land titling variable is significant with four and eight period lags, respectively; it is also significant when it is not lagged. However, it carries an unexpected negative sign, when it has no lag, but a positive sign as expected when lagged by four and eight periods, respectively. The unexpected negative sign is consistent with the results from the ECM model for the impact of land titling with one and two lags. Given that the land titling variable seems to carry negative signs at low order lags but positive signs at higher order lags, it would be useful to trace the dynamic path that is followed through this adjustment. We do so by undertaking regression analysis using the standard economic growth equation plus the two variables for land registration (land titling and public expenditure on land registration) in the same way as we have done to generate the results in columns 2 and 3 of Table 4. But this time, we undertake a separate regression analysis for each lag of the land titling variable, from zero to thirteen (13) lags. The results are summarized in Table 5.

Table 5: Response of Economic Growth ($\Delta \log Y$) to Lags in Land Titles ($\log LRT$)

Lags	LRT Coefficient	T-ratio	Level of Significance	R ²
0	-0.029114	-1.8170	**	0.49
1	0.055068	0.46100		0.50
2	0.10132	1.3117		0.53
3	0.11104	1.6190		0.55
4	0.13156	1.8818	**	0.59
5	0.13917	1.9896	**	0.57
6	0.15015	2.1903	**	0.59
7	0.13791	2.4970	**	0.65
8	0.15694	3.2849	***	0.70
9	0.17477	3.8323	***	0.74
10	0.19602	4.2924	***	0.77
11	0.15642	2.6376	***	0.75
12	0.16167	1.7874	**	0.65
13	0.13741	1.4382		0.58

** and *** indicate significance at levels of 5 and 1 percent, respectively.

Results obtained using Microfit 4.0 by Pesaran and Pesaran (1997).

With a zero lag, the land titling variable is statistically significant and carries a negative sign. But with one and more lags, the land titling variable assumes a positive sign although the variable is not statistically significant for one, two and three period lags. For higher lags ranging from 4 to 12, it becomes statistically significant, with lags 8 to 11 being strongly significant. Then the variable becomes statistically insignificant for lags higher than 12. This analysis of the response of economic growth to land titling clearly follows a J curve, first starting negative but slowly building, over 3 years, to a positive and strong response whose impact lasts for nine (9) years.

The analysis indicates that, in the long term, land registration has a strongly positive impact on economic growth, but this happens only after an initial negative impact and a slow recovery from it. Things first get worse before they get better. While the positive long term impact is expected, there is no clear explanation in literature for the initial negative impact. Therefore, we can only speculate on the causes. First, we know from literature that land registration leads to increases in land prices and speculation in land, including at times land grabbing, which often occurs before even registration has taken place (Feder and Nishio, 1998). Speculation in land may keep investments away from land since landownership would shift from land users to speculators, and high land prices discourage investments in land-intensive activities. Second, economic agents including bankers may initially develop a wait and see attitude in accepting land titles as collateral, both new and old land titles.

While the ARDL model seems to have handled well the higher order lags of the economic growth equation, the estimation results cannot be automatically declared valid given that the variables involved are only stationary at $I(1)$. To be valid, the variables in the ARDL model would have to first pass the co-integration test (see Section IIIc). A residual-based ADF test for co-integration has been conducted and its results are presented in Table 6. At the 5% level of significance, none of the ADF test statistics is more negative than the critical value of -5.2687 . This is still the case even when the various variables in the ARDL model are alternately made the dependent variable and the land titling variable lagged at various orders (the test results are not reported). Hence, we cannot reject the null hypothesis of non-cointegration⁶. We are therefore unable to say that the variables in the ARDL model are cointegrated. Consequently, given that the variables in the ARDL model are $I(1)$ and were regressed in levels, the results of the test for cointegration would suggest that the ARDL estimation results could be spurious and inconsistent. But we cannot rush to dismiss the ARDL estimation results purely based on the ADF test for cointegration as it is well known that the Dickey-Fuller test has low power especially when the sample is fairly small like the one used in this study.

⁶ There are two other alternative tests of co-integration that could have been used, namely the Johansen's (1988) and the Durbin-Watson tests (Stock and Watson, 1988). It is our judgement that these alternatives to the residual-based ADF test would not produce improved results given the small size of the sample we are dealing with.

Table 6: Residual-Based ADF Test for Co-Integration on Key Variables in the ARDL Model

Unit root tests for residuals					

Based on OLS regression of DLY on:					
INPT	LY(-1)	LLRT	LI	LT	LFD
36 observations used for estimation from 1961 to 1996					

	Test Statistic	LL	AIC	SBC	HQC
DF	-4.3942	79.6475	78.6475	77.9305	78.4138
ADF(1)	-4.5706	81.0263	79.0263	77.5923	78.5589
ADF(2)	-3.7380	81.1517	78.1517	76.0007	77.4505
ADF(3)	-4.2644	83.0405	79.0405	76.1726	78.1057
ADF(4)	-3.3245	83.0510	78.0510	74.4660	76.8824

95% critical value for the Dickey-Fuller statistic = -5.2687					
LL = Maximized log-likelihood AIC = Akaike Information Criterion					
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion					

Results obtained using Microfit 4.0 by Pesaran and Pesaran (1997).

V. Summary and Conclusions

Our study, though a single country case study, has demonstrated that an economy-wide approach to analyzing economic effects of land registration offers considerable improvements over current and past approaches which have been sector-focused. We have deployed contemporary analytical approaches, including the ECM, to deal with non-stationarity that is inherent in time series data. We have at the same time used classical techniques such as the ARDL to model high order lags that characterize the response of output and economic growth to changes in land registration.

Our empirical analysis using the ECM has generated three unambiguous findings. First, land titling is found to have statistically significant and positive long-run effects on financial development. Second, public expenditure on land registration --- an indicator of the quality of land registration services --- is found to have strongly significant and positive long run effects on economic growth. Third, land titling is found to have significantly negative effects on economic growth in the immediate period following its occurrence.

While we are able to explain the positive impact of land titling and quality of land registration services on financial development and economic growth, we are unable to explain the negative impact of land titling on economic growth. Our guess is that it may be due to the influences of price increases and speculation in land (often associated with land titling) which tend to deter investment in land and in land-intensive activities. In addition, it is possible that bankers and investors may take a wait and see attitude in transacting with new (and old) titles until the dust has cleared. Both the speculation in land and short term uncertainties in dealings with land titles could adversely impact economic growth in the short run. On the other hand, theory and supply response studies would indicate that the response of economic growth to land titling should occur with many lags which the ECM is unable to analyze; we have therefore used another model,

the ARDL model, to deal with the many response lags of economic growth to changes in land titling.

Our empirical analysis of the response of economic growth to land titling using the ARDL model indicates that there is a significant negative current effect and a significant positive long run effect. This does suggest a clear J curve effect which can be explained by the theory and is known to occur in the supply response of exports to currency devaluations⁷. Indeed theory would indicate that the likely effect is along these lines --- with uncertainties and speculation in land dampening investment and growth in the initial period followed by a long lasting recovery in economic growth. The ADF test for cointegration, based on a unit root test on the residual of the ARDL, could not reject the null hypothesis of a unit root with the implication that the relationship was not cointegrated. It is well known, however, that the Dickey-Fuller and ADF tests have low power, especially when the sample is fairly small. Hence, we are reluctant to dismiss the estimation results of the ARDL model particularly since they are consistent with theory.

Our findings on the positive long run effects of land registration on financial development and economic growth are consistent with those obtained by Feder et al. (1988, op. cit.) to the effect that land registration increases access of farmers to credit and raises farm productivity in rural Thailand. Our findings on the adverse impact of land titling on economic growth, in the immediate period following land titling, would give partial support to the findings of Mighot-Adholla et al.(1991, op. cit.) that land registration has no effect on land productivity in some Sub-Saharan African countries. But these latter findings are not supported by our findings which indicate that land titling and the quality of land registration services have significant and positive long run effects on economic growth. We would like to underscore that all these studies, against which our findings are being compared, are sector-based.

To the extent that many studies of the economic effects of land registration (including the economic justification of land titling and registration projects) are based on the assumption that economic benefits accrue to one sector, our findings suggest that they understate the benefits accruing from land registration. It is conceivable that, even in countries where sector studies have shown land registration to have had no clear impact on productivity, economy-wide studies like ours could find significant economic effects. This would support the view that new and more encompassing approaches are required to studying and justifying investments in land registration. Such approaches should not only attempt to encapsulate the measurable economic benefits that accrue economy-wide but should also recognize that land registration is an important building block for financial development and a prerequisite for economic growth particularly in transition economies and other countries with underdeveloped institutional and legal infrastructure such as those in Sub-Saharan Africa.

⁷ The J-curve terminology has normally been used to describe export supply responses to currency devaluations.

The findings of studies, such as ours, which affect public investment decisions in land registration, have profound implications for decision making by governments and donors involved in supporting economic development in developing countries and transition economies. In these countries, as much as 90 percent of rural and 50 percent of urban property rights are not protected by formal property titles; this, combined with their low level of economic development, indicates that there is considerable potential for land registration to contribute to the development of their economies and financial sectors. But given some potential negative effects of land titling on economic growth, however short-lived, decisions on public spending on land registration ought to be based on well-conducted, country-specific economic viability studies.

Some words of caution about the findings of our study are in order. First, the findings of this study are based on a one country study. They are not necessarily applicable to other countries due to country differences. The global applicability of our findings ought to be seen as a challenge for future research in the direction of cross-country and more country case studies. Second, our study has found that economic growth responds to land titling following a J curve. More research is needed to determine the underlying factors to this supply response. Third, the study has not looked at the non-economic impacts of land registration such as the social and environmental ones. These latter ones are also important in public policy and would need to be factored into the decision making processes of governments and development financiers.

Fourth, while our findings suggest that land registration is important for financial development and economic growth, land registration cannot achieve these attributed benefits on its own. In the first place, land registration must be implemented within an enabling legal and regulatory framework that is free of stringent regulatory restrictions and backed by adequate law enforcement mechanisms. In addition, land registration ought to be planned and implemented as one of the inter-dependent building blocks of a market economy including markets for finance, goods and services.

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APPENDIX 1

DESCRIPTION OF THE REGRESSION VARIABLES USED IN THE FINANCIAL DEEPENING AND ECONOMIC GROWTH EQUATIONS

Per Capita Real GDP. This is the dependent variable in the economic growth equation that is represented by annual per capita real GDP. Per capita GDP is computed by dividing the real GDP figures by the total population and is denoted as Y. It is also used as an explanatory variable in the financial deepening equation in recognition of the two way relationship between financial development and economic growth (Levine, 1996). We expect to find a positive association between per capita real GDP and financial deepening. Real GDP and population data are extracted from IMF International Financial Statistics with real GDP from line 99bp and population data from line 99z.

Financial Deepening Variable. We follow Demetriades and Luintel (1996) to discard the standard measure of financial depth used in literature -- the broad money (M2) -- and use instead the ratio of bank deposit liabilities (demand, time and savings deposits) to nominal GDP (We divide lines 24 and 25 by 99b from the IMF's International Financial Statistics). Alternatively, this ratio can be derived by deducting money in circulation from M2 in order to remove the extent of magnetization from financial deepening. Discounting for magnetization is important in the case of Thailand as it experienced a rapid growth in magnetization during the late 1970s and 1980s. This measure of the financial deepening variable is denoted as FD and was found more suitable for use in the economic growth function. We expect to find a positive association between financial deepening and economic growth. As an alternative measure of financial deepening, we also use the ratio of loans made by banks (excluding the central bank) to private enterprises divided by GDP (We divide line 22d by 99b from the IMF's International Financial Statistics). It is denoted as FDC and is found more suitable for use in the financial development equation as the dependent variable.

Land Registration. We have two variables to represent land registration. The first is land titling which is measured by the cumulative number of land registration titles issued, equivalent to the number of privately owned land parcels that have been registered. Since NS4 land certificates are the ones that are unquestionably accepted by banks for collateral arrangements, they are considered to make up the land titling variable, denoted as LR, for purposes of estimating the financial deepening equation. NS3 and NS3K land certificates, which confer to the holder the same possessory rights as NS4 but are not widely accepted by banks for collateral arrangements, are used together with NS4 in the estimation of the economic growth function. The land titling variable they constitute is denoted as LRT. The second variable for land registration is real public expenditures, both capital and current expenditures (deflated by inflation), incurred by the Department of lands in land titling and the administration of land transactions (maintenance of the land registry). This measure is meant primarily to capture the volume of business being handled in the land registry in terms of day-to-day land transactions and

the quality of maintenance of the land registry (quality of delivering land services) although some of the expenditures are often incurred on the issuing of land titles. We expect to find a positive association between land registration (both land titles and public expenditures) and financial deepening as well as economic growth. The land titling and public expenditure data has been compiled by the staff of Thailand's Department of Lands.

Real Interest Rates. The real deposit interest rate variable, denoted as RD, together with the per capita real GDP variable, are now standard variables in the financial development function, thanks to the finance and growth literature (Levine, 1996; and Demetriades and Luintel, 1996). We expect to find the real deposit interest rate variable positively associated with financial deepening. The real interest rate measure is computed by subtracting the consumer price index (CPI) figures from nominal deposit interest rates (To avoid negative numbers which cannot be converted to natural logarithms, real interest rates are computed as a ratio of nominal interest rate to CPI). The nominal interest rate (for 1977-96) and CPI data are extracted from the IMF International Financial Statistics, with deposit rates data from line 60l and CPI data from line 64. The deposit rates data for 1970-76 were obtained from the central bank of Thailand while the deposit rates data for 1960-69 were estimated by the author.

Ceilings on Deposit Rates Dummy. In an environment of financial repression, ceilings on deposit rates act as a constraint to financial development. But in a less distortionary financial system like Thailand's where ceilings on deposit rates are above inflation rates, ceilings on deposit rates help financial markets to work more efficiently (in an environment of information asymmetries and externalities) by creating rent opportunities which banks can exploit by using non-price mechanisms of competition such as opening new bank branches and promoting their services to previously unserved households (Hellman et al., 1996). They are therefore relevant in the estimation of a financial development function. In our study, we measure these controls using dummies which take the value of 1 if a control is present, and zero if there is none. We should expect to find ceilings on deposit rates dummy positively associated with financial deepening. Data on interest ceilings has been obtained from the Bank of Thailand through the World Bank Office in Bangkok.

Directed Credit to Agriculture Dummy. Directed credit programs may help achieve desirable income distributional objectives but they hamper financial development since they hinder credit from flowing to the most efficient users. A dummy variable is used and constructed in such a way that it is set at 0 when there is no directed credit program to agriculture, and to 1 and 2 when the directed program covers 0-8% and 9-16%, respectively. We should expect to find a negative association between directed credit dummy and financial deepening. The latest data on directed credit has been obtained from the Bank of Thailand through the World Bank Office in Bangkok.

Ratio of Investment to GDP. The variable is measured by gross domestic investment as a percentage of GDP. Investment enhances the capital-labor ratio and

economic growth. We therefore expect a positive association between the ratio of investment to GDP and per capita real GDP. Gross domestic investment and GDP data to construct this variable has been extracted from IMF International Financial Statistics, as the sum of lines 93e and 93I for gross domestic investment, and line 99b for GDP.

Investment in Human Capital. The positive role of human capital in the growth process marks one of the key differences between neo-classical and endogenous growth models where, in the latter, human capital is an important element in a country's ability to generate and/or absorb new ideas, thereby facilitating growth (Barro, 1991; Romer, 1986). We measure it using secondary school enrolment, expressed as the annual percentage of the relevant age group (12-17 years) enrolled in secondary education. We should expect to get a positive association between secondary school enrolment and per capita GDP. The enrolment data was originally compiled by UNESCO and was obtained from World Bank's World Development Indicators.

Ratio of Trade to GDP. The measure of the ratio of trade to GDP is used as an indicator of outward orientation which is good for economic growth but not unambiguously so. On the one hand, openness to trade can increase growth by improving the access to imported inputs in which new technology is embodied, and by increasing the size of the markets that the country can exploit. On the other hand, growth can be hurt by reductions in research and development (R&D) expenditures which imports can cause as they increase competition in local markets thereby reducing expected profits (Ghani, 1992). Trade ratios are computed by adding annual exports and imports and dividing the sum by GDP. We expect to find a positive relationship between trade shares in GDP and growth in per capita real GDP. The import, export and GDP figures were obtained from IMF International Financial Statistics, lines 78abd, 78aad and 99b, respectively.

Population. Population is used as a proxy for growth in the labor force. As the Thai economy grew rapidly in the 1980s and early 1990s and faced labor shortages, as many as two million foreign workers were imported annually. This would indicate that growth in the labor force is a relevant factor for Thailand's economic growth, consistent with the endogenous growth theory. We expect a positive relationship between population and per capita real GDP. Population data has been obtained from the IMF International Financial Statistics, line 99z.

Ratio of Manufactures to GDP. The ratio of manufactures variable is meant to represent the structure of production which might have an effect on the average technical progress that occurs in an economy. Economic growth will rise with increases in the share of the sectors where technical progress is important (Grossman and Helpman, 1991). We therefore follow in the steps of Torstensson (1994) and de Long and Summers (1991) to use the share of manufactures in GDP as an explanatory variable for economic growth. We obtain data on manufactures (value added) from the World Bank's World Development Indicators and GDP from the IMF International Financial Statistics (line

99b). We expect to find a positive relationship between the ratio of manufactures to GDP and per capita GDP.

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